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Databases (see over)

(i) UK Patent Office

(ii)

Search Examiner

M J BILLING

Date of Search

23 APRIL 1993

Documents considered relevant following a search in respect of claims 1-6

Category (see over)	Identity of document and relevant passages	Relevant to claim(s)
Y	GB 2237466 A (KIJIMA) eg. See Figures 1, 6; page 14, lines 1-3	1, 2, 3, 4, 6 at least
Y	GB 1346406 (PHILIPS) eg. See Figure 2	1, 2, 3 4, 6 at least
Y	GB 1266130 (KIRK) eg. See Figure 1	1, 2, 3, 4, 6 at least
Y	GB 1032125 (WESTERN) eg. See Figure 2	6 at least

Category	Identity of document and relevant passages	Relevant to claim(s)
	17	

Categories of documents

X: Document indicating lack of novelty or of inventive step.

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A: Document indicating technological background and/or state of the art.

P: Document published on or after the declared priority date but before the filing date of the present application.

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Databases: The UK Patent Office database comprises classified collections of GB, EP, WO and US, patent specifications as outlined periodically in the Official Journal (Patents). The on-line databases considered for search are also listed periodically in the Official Journal (Patents).

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(54) A fluorescent lamp lighting arrangement for "Smart" buildings.

(57) A fluorescent lamp lighting arrangement controlled by both a motion detector and a light sensing detector operable when said motion detector senses motion.

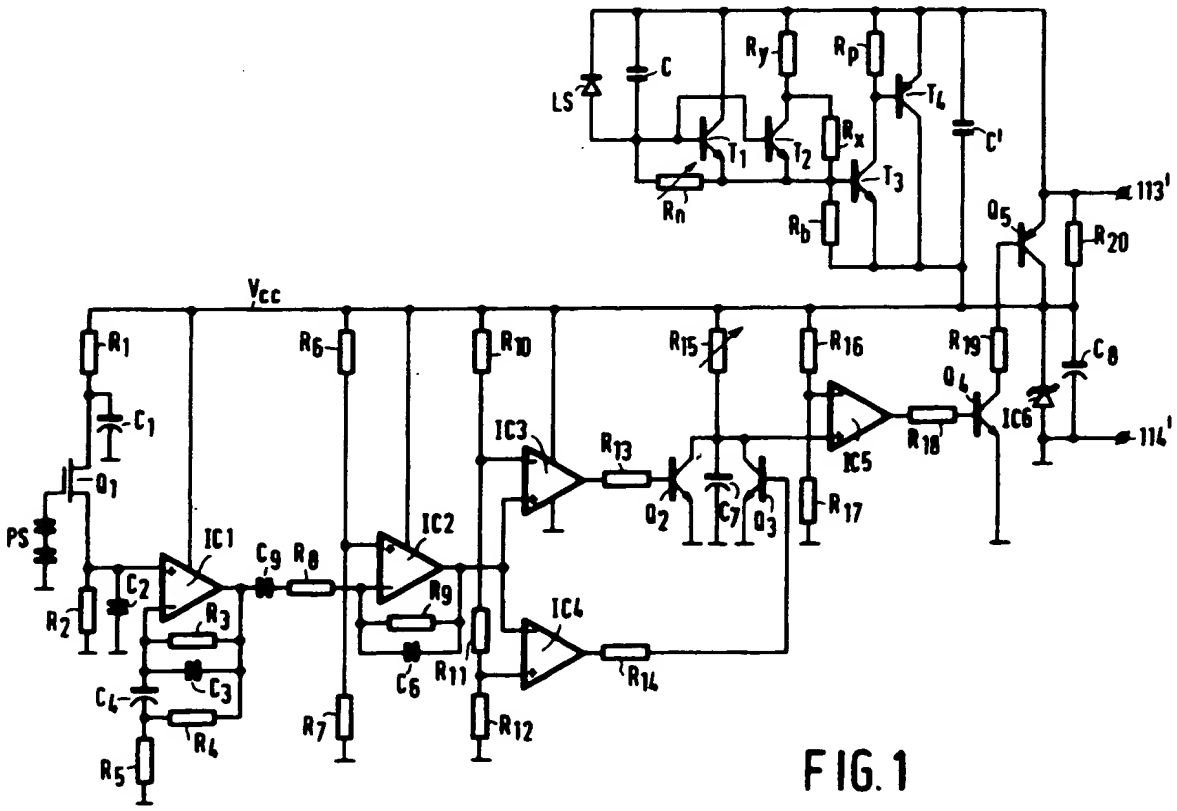


FIG. 1

EP 0 510 751 A2

This is an invention in the lighting art. More particularly, it involves a fluorescent lamp lighting arrangement with an integral motion detector and light sensing detector for controlling the fight intensity of fluorescent lamps.

This invention is related to that disclosed in U.S. patent application serial No. 599,337 of Stefan F. Szuba filed on October 17, 1990 under the title "A Fluorescent Lamp Arrangement with an Integral Motion Sensor" and U.S. Patent Application Serial No. 450,143 of Stefan F. Szuba filed December 11, 1989 under the title "Method for Controlling Fluorescent Lamp Dimmers and Circuit For Providing Such Control" both of which are assigned to the same assignee as this application. Application serial Nos. 599,337 and 450,143 and U.S. Patent No. 5,003,230 and U.S. Patent No. 4,952,849 describing fluorescent lamp controllers and all matter incorporated by reference therein is hereby incorporated by reference herein.

One of the objects of this invention is to conserve energy.

One of the advantages of the invention is that it increases the life of fluorescent lamps operated under its control.

One of the features of the invention is that it is useful in so-called "Smart" buildings. In this respect, it will dim fluorescent lamps under its control in areas in which no activity is sensed and will vary the amount of artificial light in such areas in accordance with how much natural light strikes such areas, when activity is sensed.

In accordance with one aspect of the invention, there is provided a fluorescent lamp lighting arrangement including a fluorescent lamp and lamp controller means for controlling the light intensity of the lamp. A control signal means is also included which responds to a predetermined stimulus and produces a control signal when the stimulus occurs. Operating means are provided to respond to the control signal to cause the controller means to change the light intensity of the fluorescent lamp. The operating means includes first and second stages. The first stage includes amplifier means for amplifying the control signals. The second stage includes a voltage regulating means for regulating a first operating voltage applied to the amplifier means for its operation. The voltage regulating means receives a second operating voltage for its operation from the lamp controller means. The amplifier means includes a comparator circuit means operating to render the lamp controller means insensitive to signals from said control signal means less than a predetermined magnitude.

In accordance with another aspect of the invention there is provided a fluorescent lamp lighting arrangement including a fluorescent lamp and lamp controller means for controlling the light intensity of the lamp. A control signal means is also included which responds to a predetermined stimulus and produces a control signal when the stimulus occurs. Operating means are provided to respond to the control signal to cause the controller means to change the light intensity of the lamp. The operating means includes a light control circuit which responds to the control signal and operates to control the amount of light provided by the fluorescent lamp at a prescribed location in accordance with a predetermined curve. The light control circuit includes light sensing means sensing the amount of illumination at the prescribed location provided by natural light and by the fluorescent lamp. The predetermined curve has a steep slope when the light sensing means indicates the fluorescent lamp should provide a high amount of light and a more moderate slope when the light sensing means indicates the fluorescent lamp should provide a lesser amount than the high amount. The light control circuit includes determination means for determining at what amount of light from the fluorescent lamp the curve is transposed from the steep slope to the more moderate slope.

In accordance with a still further aspect of the invention, there is provided a fluorescent lamp lighting arrangement including a fluorescent lamp and lamp controller means for controlling the light intensity of the lamp. A control signal means is also included which responds to a predetermined stimulus and produces a control signal when the stimulus occurs. Operating means are provided to respond to the control signal to cause the controller means to change the light intensity of the lamp. The operating means includes first and second stages. The first stage includes amplifier means for amplifying the control signal. The second stage includes a voltage regulating means for regulating a first operating voltage applied to the amplifier means for its operation. The voltage regulating means receives a second operating voltage for its operation from the lamp controller means. The operating means includes a light control circuit which responds to the control signal and operates to control the amount of light provided by the fluorescent lamp at a prescribed location. The light control circuit includes light sensing means sensing the amount of illumination at the prescribed location provided by natural light and by the fluorescent lamp. The light control circuit includes determination means for determining what amount of light is to be provided by the fluorescent lamp.

Other objects, features and advantages of the invention will be apparent from the following description and appended claims when considered in conjunction with the accompanying drawing in which:

Fig. 1 is a circuit diagram of a motion and light

sensor in accordance with the invention, and Fig. 2 is a graph plotting the illumination at the light sensor of the circuitry of Fig. 1 against the amount of artificial light provided by the lighting arrangement of the invention.

A preferred embodiment of a sensor circuitry for use with for instance a dimmable fluorescent lamp controller as described in US Patent application 500,32,30 is shown in Figure 1. The sensor circuit comprises terminals 113' and 114' suitable for connection to input terminals of the dimmable fluorescent lamp controller. In operation the sense circuit receives power via terminals 113' and 114'. Furthermore the sensor circuit adjusts the voltage present between terminal 113' and terminal 114', this voltage serving as a dimming signal for the dimmable fluorescent lamp controller and determining the light output of the lamps operated by the dimmable fluorescent lamp controller. Such a sensor circuit would be useful in dimming lamps in a room when there is no activity in the room and for brightening those lamps when the sensor senses that there is activity in the room. The apparatus comprises a pyroelectric motion sensor PS. This unit produces signals which vary in time and whose amplitude increases as it senses increasing infrared radiation. In operation with resistors R_1 and R_2, capacitances C_1 and C_2 and transistor Q_1, the signals from sensor PS are applied to the positive input of a first amplifier stage IC_1. As indicated in Figure 1, capacitance C_1, sensor PS, resistor R_2 and capacitor C_2 are all connected to a common return line as are various other elements of Figure 1 as indicated by the small horizontal line shown at the bottom of each of the elements connected to the return line. Resistors R_3, R_4 ad R_5 together with capacitors C_3 and C_4 are selected in order to give operational amplifier IC_1 a high AC gain. The output of operational amplifier IC_1 is fed through capacitor C_5 and resistor R_8 to the inverting input of a second stage amplifier formed by operational amplifier IC_2. Resistors R_6, R_7, R_9 and capacitor C_6 are selected to provide operational amplifier IC_2 with a high AC gain also. Since the input from operational amplifier IC_1 is applied to the inverting input of operational amplifier IC_2, the output of the latter amplifier is an amplified inversion of its input.

The output of amplifier IC_2 is fed to what is termed a "window comparator" formed by amplifiers ICL3 and IC_4. Amplifier IC_3 filters out positive signals received from amplifier IC_2 below a particular value whereas amplifier IC_4 filters out negative signals above a particular value. In this way, background radiation which might impinge on pyroelectric sensor PS is filtered such that the apparatus is insensitive to such background radiation. The magnitudes of the positive and negative signals which are filtered out is determined by the resistance values of resistors R_{10}, R_{11} and R_{12}.

The outputs of amplifiers IC_3 and IC_4 pass through resistors R_{13} and R_{14}, respectively to turn on either of transistors Q2 and Q3 in the presence of sufficient motion as sensed by sensor PS. With either of transistors Q2 or Q3 on, capacitor C_7 is discharged quickly through either of the low impedance collector-emitter paths so provided. Motion sensed by pyroelectric sensor PS discharges capacitor C_7 rapidly to brighten lamps operated by the dimmable fluorescent lamp controller with a relatively short time delay if they were at their-dimmed condition, as will be explained. In response to the indication of a lack of motion by pyroelectric sensor PS, capacitor C_7 charges slowly through rheostat R_{15}. The lack of motion dims the lamps from their brightened condition after a time delay determined by the magnitudes of capacitor C_7 and rheostat R_{15} which is relatively longer than the time delay for brightening the lamps.

The voltage representative of the charge on capacitor C_7 is applied to the positive input of comparator IC_5 which compares it with a threshold voltage established by resistors R_{16} and R_{17}. If the voltage at the positive input is higher than the threshold voltage, the output of comparator IC_5 is high and is applied through resistor R_{18} to turn on transistor Q_4.

Transistors Q_4 and Q_5 together with resistor R_{19}, and zener diode IC_6 form a switch for switching the voltage across terminals 113' and 114' depending upon whether or not pyroelectric sensor PS senses motion. If motion is sensed, the output of comparator IC_5 is low and transistor Q_4 is turned off. As a result, transistor Q_5 is also maintained in an off condition and resistor R_{20} is in series circuit with Adjustable Micropower Voltage Reference IC_6. Under these conditions, the voltage applied across terminals 113' and 114' by the dimmable fluorescent lamp controller can remain high. As a consequence the lamps can operate at what may be called a "fully lit" condition.

Should motion in the vicinity of pyroelectric sensor PS cease, comparator IC_5 produces a high signal to turn transistor Q_4 on. As a result, transistor Q_5 is also turned on short-circuiting resistor R_{20}. This causes the current being sourced by terminals 113' and 114' to increase in value while the voltage across those terminals decreases in value to approximately the voltage drop across Adjustable Micropower Voltage Reference IC_6 - (such as a National Semiconductor Corp. LM 185). This voltage causes the lamps to operate in a "dimmed" condition.

Adjustable Micropower Voltage Reference IC_6 forms a voltage regulating means for producing the

operating voltage for amplifiers IC_1 through IC_5 along line V_{cc}. The voltage regulating means is capable of maintaining the voltage along lines V_{cc} within an acceptable range for the operation of amplifiers IC_1 through IC_5 notwithstanding the voltage across terminals 113' and 114' changes from high to low depending upon whether resistor R_{20} is in series circuit with Adjustable Micropower Voltage Reference IC_6 or whether it is shorted by transistor Q_5.

From the foregoing, it will be understood that the switch formed by transistor Q_4 and Q_5 together with the voltage regulating means identified above receive their operating voltage across terminals 113' and 114' and their power for operation from the (dimmable fluorescent) lamp controller. The amplifiers IC_1 through IC_5 of the control signal means of Figure 1 receive their operating voltage through the voltage regulator means along line V_{cc}. As a consequence, none of the previously described controlled signal means of Figure 1 requires a source of voltage independent of the lamp controller.

Superimposed upon the previously described motion sensor of Figure 1 is a light sensor arrangement including light sensor LS and transistors T_1 - T_4 with associated resistive elements and capacitors. This circuitry is connected to terminal 113' and line V_{cc}. As can be seen in Figure 1, there is provided a light sensor LS which senses light at a particular location. Light sensor LS is connected across capacitor C, one end of which is connected to the base of NPN transistor T_1. The other end of capacitor C is connected to the collector of transistor T_1.

The emitter of transistor T_1 is connected to one end of rheostat R_h, the other end of which is connected to one end of light sensor LS and to the base of transistor T_1. The emitter of transistor T_1 is also connected to the base of NPN transistor T_3 and to the emitter of NPN transistor T_2. The bases of transistor T_1 and T_2 are interconnected. The collector of transistor T_2 is connected to one end of resistor R_y, the other end of which is connected to the other end of capacitor C. The emitter of transistor T_2 is also connected to one end of resistor R_b, the other end of which is connected to line V_{cc}.

Connected across the emitter and collector of transistor T_2 is resistor R_x. The collector of transistor T_3 is connected to one end of resistor R_p, the other end of which is connected to the other end of capacitor C. The one end of resistor R_p is also connected to the base of PNP transistor T_4. The other end of resistor R_p is connected to the emitter of transistor T_4. The emitter of transistor T_4 is also connected to terminal 113'. The collector of transistor T_4 is connected to line V_{cc}.

When transistor Q_5 is non-conducting, because the motion sensor senses activity, the voltage present between terminal 113' and terminal 114' is controlled by the light sensor arrangemnent including light sensor LS and transistor T_1-T_4 with associated resistive elements and capacitors.

The curve shown in Figure 2 is the result of experimentation at work places, and shows the amount of artificial light as a function of the Illumination (IL) at sensor LS. Those skilled in the art will understand from the disclosure herein that different curve slopes may be employed. The curve of Figure 2 represents the output of fluorescent lamps controlled in accordance with the invention versus the illumination at the light sensor. The upper steep slope portion of the curve, that is, the portion from A to B provides lumen maintenance control and ambient light regulation. The lower part with the more moderate slope, that is, portion B to C of the curve performs ambient light regulation only. It is to be understood that this curve has been selected to provide optimum electrical energy use and optimum quality of lighting.

In operation, transistors T_1, T_2, T_3 and T_4 are provided power for operation from the dimmable fluorescent lamp controller. No auxiliary power supply is required. Rheostat R_h acts as a threshold control or selection means. Transistor T_4 is the main current sink of the invention. Transistor T_3 operates as a regulation amplifier and as a partial current sink. Transistors T_1 and T_2 form a variable gain photo current amplifier. Transistors T_1 and T_2 work in such a way that at low natural light levels they have a high current gain. At this high gain the upper portion A to B of the curve of Figure 16 is provided substantially by the fluorescent lamp or lamps being controlled. At higher natural light levels transistor T_2 saturates and this results in a relatively low current gain of the amplifier formed by transistors T_1 and T_2. This provides the more moderate portion of each curve from point B to point C. The value of resistor R_y and the current gain of transistors T_1 and T_2 determine the location B on each of the curves of Fig. 2.

Resistors R_y and R_x are selected to obtain the desired steep slope of the curve between its A point and its B point. R_p serves to establish a bias for transistor T_4. R_b serves to establish initial voltage gain for the circuit. Capacitors C and C' provide voltage filtering.

It should be apparent that various modifications of the above will be evident to those skilled in the art and that the arrangement described herein is for illustrative purposes and is not to be considered restrictive.

Claims

1. A fluorescent lamp lighting arrangement suit-

able for operating at least one fluorescent lamp. including lamp controller means for controlling the light intensity of said lamp, and a sensor circuit comprising control signal means responding to a predetermined stimulus and producing a control signal when said stimulus occurs, and comprising operating means responding to said control signal to cause said controller means to change the light intensity of said lamp, said operating means including first and second stages, said first stage including amplifier means for amplifying said control signals, said second stage including a voltage regulating means for regulating a first operating voltage applied to said amplifier means for its operation, said voltage regulating means receiving a second operating voltage for its operation from said lamp controller means, said amplifier means including a comparator circuit means operating to render said lamp controller means insensitive to signals from said control signal means less than a predetermined magnitude.

2. A fluorescent lamp lighting arrangement suitable for operating at least one fluorescent lamp, lamp controller means for controlling the light intensity of said lamp, and a sensor circut comprising control signal means responding to a predetermined stimulus and producing a control signal when said stimulus occurs, and comprising operating means responding to said control signal to cause said controller means to change the light intensity of said lamp, said operating means including a light control circuit which responds to said control signal and operates to control the amount of light provided by said fluorescent lamp at a prescribed location in accordance with a predetermined curve, said light control circuit including light sensing means sensing the amount of illumination at the prescribed location provided by natural light and by said fluorescent lamp, said predetermined curve having a steep slope when said light sensing means indicates said fluorescent lamp should provide a high amount of light and a more moderate slope when said light sensing means indicates said fluorescent lamp should provide a lesser amount than said high amount, said control circuit including determination means for determining at what amount of light from said fluorescent lamp said curve is transposed from said steep slope to said more moderate slope.

3. A fluorescent lamp lighting arrangement including a fluorescent lamp, lamp controller means for controlling the light intensity of said lamp, and a sensor circuit comprising control signal means responding to a predetermined stimulus and producing a control signal when said stimulus occurs, and comprising operating means responding to said control signal to cause said controller means to change the light intensity of said lamp, said operating means including first and second stages, said first stage including amplifier means for amplifying said control signals, said second stage including a voltage regulating means for regulating a first operating voltage applied to said amplifier means for its operation, said voltage regulating means receiving a second operating voltage for its operation from said lamp controller means, said operating means including a light control circuit which responds to said control signal and operates to control the amount of light provided by said fluorescent lamp at a prescribed location, said control circuit including light sensing means sensing the amount of illumination at the prescribed location provided by natural light and by said fluorescent lamp, said light control circuit including determination means for determining what amount of light is to be provided by said fluorescent lamp.

4. A fluorescent lamp lighting arrangement as claimed in Claim 1 or 3, wherein said voltage regulating means includes switch means for reducing the second operating voltage applied to said voltage regulating means in the absence of said control signal from the magnitude of said second operating voltage applied in the presence of said control signal, said voltage regulating means providing substantially the same first operating voltage to said amplifier means regardless of the magnitude of said second operating voltage applied to said voltage regulating means .

5. A fluorescent lamp lighting arrangement as claimed in Claim 1, 2 or 3, wherein said control signal means includes a pyroelectric sensor serving as a motion detector.

6. A fluorescent lamp lighting arrangement as claimed in claim 1, 2 or 3, wherein said operating means operates in response to said control signal to cause said controller means to raise the light intensity of said lamps in the presence of movement sensed by said motion detector and to cause said controller means to dim the light intensity of said lamps in the absence of motion sensed by said motion detector.

7. A fluorescent lamp lighting arrangement as claimed in Claim 6, wherein said controller means raises the light intensity of said lamp from a dimmed condition with a shorter time delay than the time delay which it provides when it dims said lamp in the absence of motion.

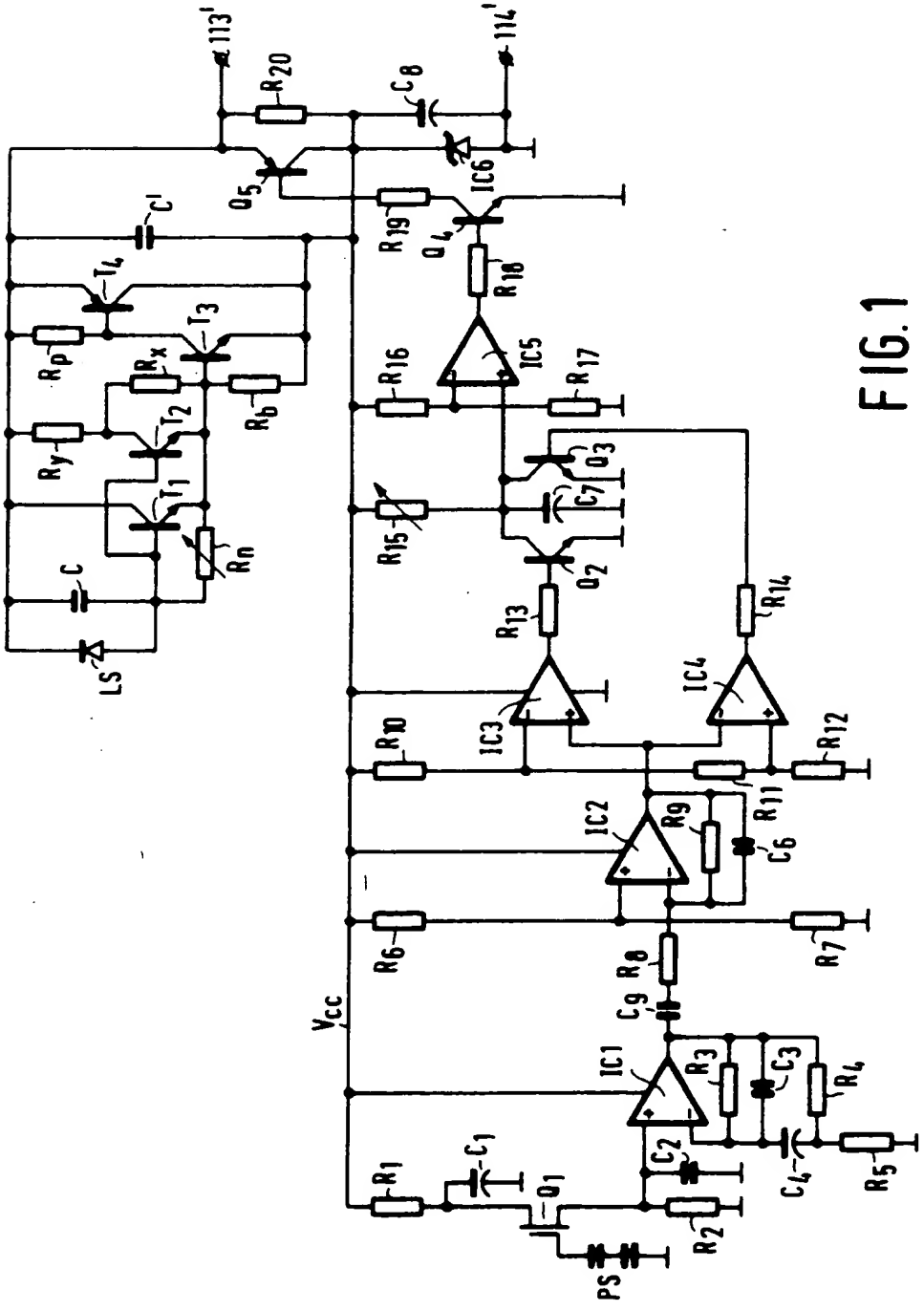
8. A fluorescent lamp lighting arrangement according to Claim 2 or 3, wherein said light control circuit includes a photo amplifier comprising a pair of transistors which operate at a high current gain at low natural light levels.

9. A fluorescent lamp lighting arrangement according to claim 8, wherein one of said pair of transistors saturates at a relatively high natural light level.

10. A fluorescent lamp lighting arrangement according to claim 9, wherein said determination means includes a resistor connected to the collector of said one of said pair of transistors.

11. A fluorescent lamp lighting arrangement according to claim 10, wherein said determination means includes a resistor connected across the collector and emitter of said one of said pair of transistors.

12. Sensor circuit sutable for use in a fluorescent lamp lighting arrangement according to any of the previous claims.


113'
114'
R20
C8
IC6
Q5
Q4
R19
R18
C'
T4
T3
T2
T1
Rp
Rx
Rb
Ry
Rn
C
LS
R16
IC5
R17
Q3
C7
R15
Q2
R13
R14
IC4
IC3
R10
R12
IC2
R9
R11
C6
R6
R7
R8
C9
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R4
C2
C4
R5
C1
R1
Q1
R2
PS

FIG.1

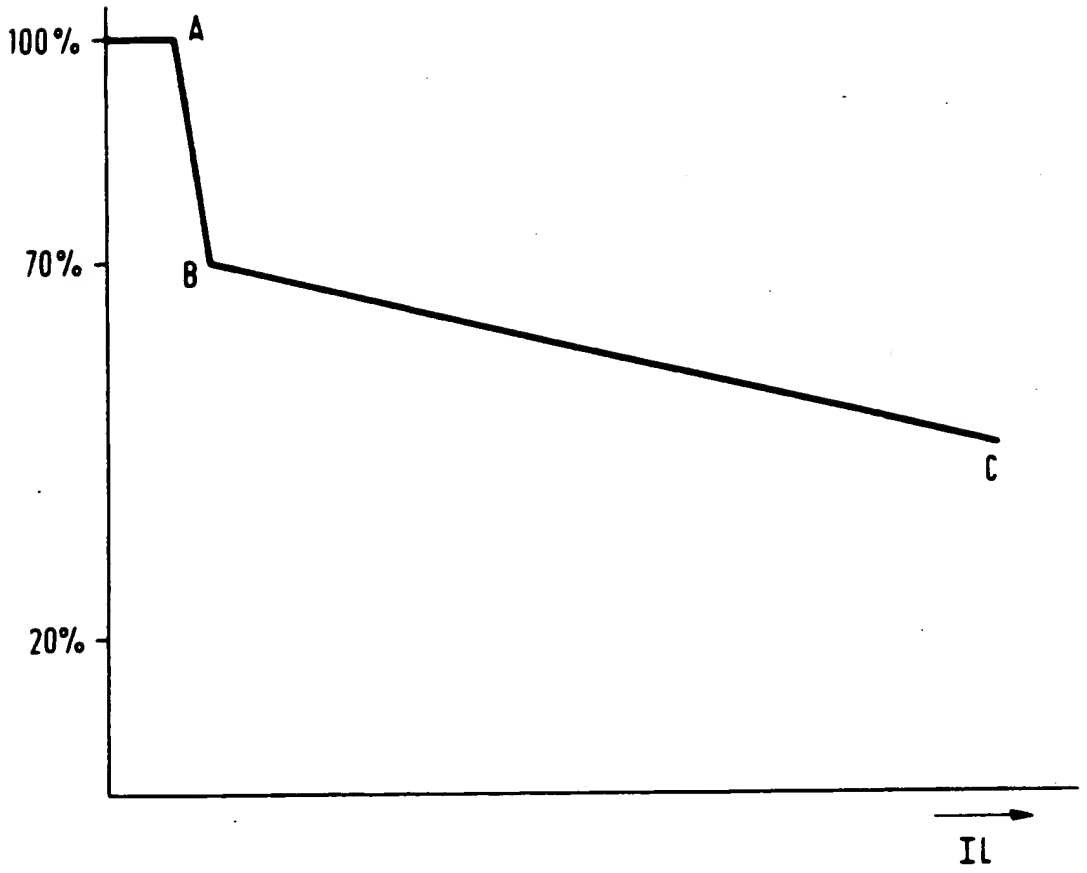

FIG. 2

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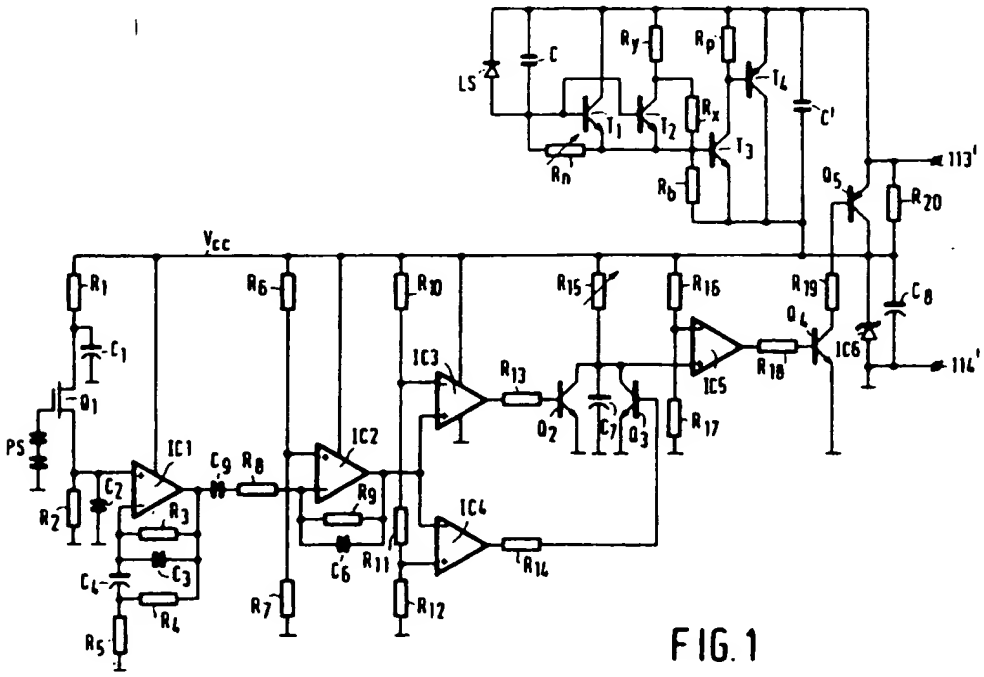

FIG.1

EP 0 510 751 A3

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EUROPEAN SEARCH REPORT

Application Number

EP 92 20 1047

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl.5)
X,P	EP-A-0 447 136 (THORN) * abstract; figure 5 *	1,3,5	H05B41/36 H05B37/02 H05B41/392
A,D,P	EP-A-0 432 845 (PHILIPS) * the whole document *	1-4,6-12	
A	US-A-4 843 283 (CHEN)		
A	US-A-4 663 521 (MAILE)		

TECHNICAL FIELDS SEARCHED (Int. Cl.5)

H05B

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	23 SEPTEMBER 1993	SPEISER P.

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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